

REMARKS

Upon entry of the present amendment, claims 1-3 will remain pending in the above-identified application and stand ready for further action on the merits.

Claims 1 and 2 have been amended so as to further clarify the features of the present invention, respectively. New claim 3 has been added.

The instant amendment made herein to the claims does not incorporate new matter into the application as originally filed. For example, the amendment to claim 1 is based on the description of the instant specification at page 7, lines 25-37. New claim 3 is based on the description of the instant specification at page 8, lines 5-10.

Further, the instant amendment does not raise substantial new issues for the Examiner's consideration and require no further search on the Examiner's part. At the same time, the instant amendments put the pending claims in condition for allowance and into a more proper format for issuance in a United States patent, by overcoming all outstanding rejections and objections of record.

Accordingly, proper consideration of each of the pending claims (i.e., claims 1 to 3) is respectfully requested at present, as is entry of the present amendment.

Interview

Applicants appreciate the Examiner's courtesy in allowing Applicants' Representatives to conduct a personal interview at the USPTO on February 21, 2007. The Examiner's comments as set forth in the Interview Summary Form are correct with respect to the discussion that took place during the interview.

Rejections under 35 U.S.C. § 103

At pages 2-4 of the Office Action, the Examiner sets forth the following rejections:

1. A rejection of claim 1 under 35 USC § 103(a) as being unpatentable over Vestal US '529 (US 4,958,529) in view of Huber US '976 (US 4,989,976), Barnes US '935 (US 4,688,935) and Carnahan US '861 (US 5,723,861); and
2. A rejection of claim 2 under 35 USC § 103(a) as being unpatentable over Vestal US '529 in view of Huber US '976, Barnes US '935 and Carnahan US '861, as applied to claim 1, and further in view of Mitsumaki US '183 (US 4,696,183).

Applicants respectfully traverse, and request reconsideration and withdraw of each of these rejections based upon the following considerations.

The Present Invention and Its Advantages

As recited in claim 1, the present invention is directed to a liquid organometallic compound vaporizing and feeding system comprising:

(1) a liquid reagent container containing a liquid reagent containing a liquid organometallic compound and impurities, a vaporizer for vaporizing the liquid reagent, a liquid reagent passageway connecting said container to said vaporizer and having a liquid mass flow controller disposed therein for controlling the flow rate of the liquid reagent;

(2) a carrier gas source, a carrier gas passageway connecting said carrier gas source to said vaporizer so as to carry a mixture of vaporized liquid reagent and the carrier gas and having a gas mass flow controller disposed therein for controlling the flow rate of the carrier gas;

(3) a sample gas passageway including one end connected to a gas outlet of said vaporizer and another end connectable to a sample inlet of an ICP emission spectrometer, and

having an in-line monitor for measuring concentration of vaporized liquid reagent in the mixture disposed therein; and

(4) a gas cylinder filled with a standard gas for calibration, and a standard gas passageway connecting said gas cylinder to said sample gas passageway at a position downstream of said in-line monitor and having a gas mass flow controller disposed therein for controlling the flow rate of the standard gas. (Emphases added)

In short, the present invention has features such as employment of i) a liquid mass flow controller for controlling the flow rate of a liquid reagent and ii) an in-line monitor for measuring concentration of vaporized liquid reagent in a mixture of a vaporized liquid reagent and a carrier gas disposed downstream of the vaporizer (and upstream of an ICP emission spectrometer).

Regarding the term "in-line monitor", at page 5 of the Office Action, the Examiner has made comments, as follows:

"Applicants' argument that Vestal does not disclose an in-line monitor is not persuasive. The term "in-line monitor" is not a well-known term that has a specific definition. The claims also do not recite the function or the purpose of the in-line monitor. Therefore, any device capable of monitoring a gas constitutes an in-line monitor. The momentum separator disclosed by Vestal constitutes an in-line monitor. It monitors the aerosol flowing through the flow chamber and increases the concentration of particles of interest relative to the solvent vapor and carrier gas."

However, in the present amendment, claim 1 has been amended by reciting that "*an in-line monitor for measuring concentration of vaporized liquid reagent in the mixture disposed therein*," so as to further clarify a meaning of an in-line monitor. Please also note that "*the mixture*" represents "a mixture of vaporized liquid reagent and the carrier gas" (see "(2)" in claim 1). In short, the phrase "*concentration of vaporized liquid reagent in the mixture*"

represents a ratio of amount of vaporized liquid reagent to amount of mixture of carrier gas and vaporized liquid reagent.

Thus, upon entry of the present amendment, the present invention has been further distinguished from the cited references.

Further, regarding a relationship between the claimed vaporizing and feeding system and the ICP spectrometer, the instant specification explains at pages 15-16, as follows:

"In the liquid organometallic compound vaporizing and feeding system of the invention, a liquid organometallic compound flowing from a reagent container is accurately measured and controlled for flow rate by a mass flow controller and then vaporized and mixed with a carrier gas in a vaporizer, and the concentration of the completely vaporized organometallic compound is confirmed by an in-line monitor. Thus the organometallic compound gas having an accurate concentration can always be introduced into the ICP spectrometer. Also since a calibration standard gas can be fed directly to the ICP spectrometer, qualitative and quantitative analyses can be performed in-line on the concentrations of impurities remaining in the organometallic compound gas. This eliminates the cumbersome and dangerous operation of sampling the liquid organometallic compound by means of a dispenser such as a syringe, significantly increasing the safety to humans and avoiding the risk of contamination during the sampling operation. ICP analysis using minute quantities of expensive organometallic compound is possible at very high sensitivity and in a reproducible manner." (Emphases added)

In short, the concentration of the liquid organometallic compound in the liquid reagent is measured with the in-line monitor, while the concentration of the impurities in the liquid reagent is measured with the ICP emission spectrometer.

Further, as described at page 8 of the specification, the in-line monitor (for example, see also "5" in Fig. 1 of the present application) is a device of measuring the concentration of reagent in a mixture of vaporized liquid reagent and carrier gas through a sample gas passageway (for

example, see also "G4" in Fig. 1 of the present application) for determining whether or not the concentration of reagent gas to be fed to the ICP spectrometer is at the predetermined value. An in-line monitor has therein, for example, an IR absorption cell and an IR detector (see claim 3). A principle of measurement is such that the organometallic compound gas is passed through the IR absorption cell, the IR absorption characteristic of the gas is measured with the IR detector, and a concentration is computed therefrom.

Please note that metal-carbon bond has a specific vibration number (i.e., frequency). When an organometallic compound having the metal-carbon bond is present in a sample gas, a wave having a specific wavelength corresponding to a specific vibration number is absorbed in IR. A concentration of the organometallic compound is obtained by comparing the absorbance at the specific wavelength with a calibration curve. In practice, for example, the absorbance of the sample is determined by the in-line monitor and the concentration of the organometallic compound is displayed thereon.

Accordingly, the concentration of organometallic compound is exactly measured by the in-line monitor; while the concentration of the impurities is exactly measured by ICP spectrometer; and hence the exact concentration of impurities to the exactly measured concentration of the organometallic compound can be obtained with the claimed system.

On the other hand, in conventional technologies such as an exponential dilution method, the sample to be analyzed is taken by a dispenser such as a syringe and is introduced into an ICP to measure the concentration of impurities. In such a conventional manner, the concentration of the organometallic compound cannot be analyzed accurately, but can be merely estimated as the amount obtained by subtracting the concentration of the impurities measured by ICP from the

sample quantity taken by the dispenser. Therefore, according to the conventional manner, an accurate concentration of the organometallic compound cannot be obtained.

Further, as recited in claim 2, another feature of the liquid organometallic compound vaporizing and feeding system of the invention is that quantitative and qualitative analyses of a wide variety of impurities can be instantaneously performed since a plurality of standard gases for calibration can be generated at the same time. In this case, such a calibration of standard gases can be divided into a few groups so that chemical reaction between the compounds used in the standard gases can be prevented.

Distinctions over Vestal US '529

Vestal '529 merely discloses an interface provided for receiving effluent from a chromatographic device and outputting sample particles of interest to a detector for analysis.

However, Vestal '529 fails to disclose or teach the use of i) a liquid mass flow controller for controlling the flow rate of the liquid reagent and ii) an in-line monitor for measuring concentration of vaporized liquid reagent in a mixture of a vaporized liquid reagent and a carrier gas disposed downstream of the vaporizer (and upstream of the ICP emission spectrometer), as recited in claim 1.

Thus, according to Vestal '529, a concentration of vaporized liquid reagent in the mixture cannot be measured accurately.

On the other hand, in the present invention, since i) a liquid mass flow controller for controlling the flow rate of the liquid reagent and ii) an in-line monitor disposed downstream of the vaporizer are employed for introducing the sample into the ICP, a concentration of vaporized

liquid reagent in the mixture to be introduced to the ICP is measured accurately, eventually the concentration of impurities in the sample is also measured more accurately.

Accordingly, Vestal '529 does not give any motivation to arrive at the present invention since the cited reference fails to disclose or teach the use of i) the liquid mass flow controller and ii) the in-line monitor disposed downstream of a vaporizer.

Distinctions over Huber US '976

Huber US '976 discloses the following:

"In a device for supplying liquid to an atomization device operating with a nebulizer (22) in a spectrometer, the liquid is fed to the nebulizer (22) by a peristaltic pump (10) through a supply conduit (12). A valve (18) responding to liquid pressure is arranged closely in front of the nebulizer (22) and controls a connection between the supply conduit (12) and an outlet (30) through which excess liquid can flow off. A sensor (44) responding to the opening of the valve (18) is adapted to control the speed of the peristaltic pump (10), such that the quantity fed by the peristaltic pump (10) is slightly larger than the feeding capacity of the nebulizer (22)." (see Abstract)

Huber US '976 merely discloses the use of a liquid flow controller.

However, Huber US '976 fails to disclose or suggest an in-line monitor for measuring concentration of vaporized liquid reagent in a mixture of a vaporized liquid reagent and a carrier gas disposed downstream of the vaporizer (and upstream of the ICP).

If only the liquid mass flow controller is provided without the in-line monitor, as described in Huber US '976, the amount of a sample introduced in ICP cannot be measured correctly. Thus, the accurate analysis cannot be achieved with the devise of Huber US '976 since a significant difference in the concentration of impurities between the real value and the measured value occurs.

On the other hand, in the present invention, the concentration of the sample is directly measured with an in-line monitor, and subsequently the sample is introduced in the ICP.

Therefore, the concentration of impurities can be correctly measured.

Accordingly, Huber US '976 does not give any motivation to arrive at the present invention.

Distinction over Barnes US '935

First, Barnes US '935 fails to disclose or suggest the in-line monitor (i.e., an in-line monitor for measuring concentration of vaporized liquid reagent in a mixture of a vaporized liquid reagent and a carrier gas disposed downstream of the vaporizer (and upstream of the ICP)).

Barnes US '935 discloses a method of analyzing a volatile, air or moisture sensitive or pyrophoric, liquid, organometallic compound for an impurity comprising inserting a sample of the compound into an exponential dilution flask, allowing substantially the entire sample to vaporize, and analyzing the vapor by plasma spectroscopy; or decomposing the sample by dropwise addition into frozen aqueous acid, diluting the decomposed sample with water, and analyzing the diluted, decomposed sample by plasma spectroscopy.

However, Barnes US '935 fails to disclose or suggest the in-line monitor disposed downstream of a vaporizer.

Next, Barnes US '935 has problems. As disclosed at column 4, line 15, in Barnes US '935, the liquid sample is injected by using a syringe. The use of the syringe can render analysis unfavorable (e.g., (i) a possibility of human damage caused by poisoning or burn during the

sampling operation and introduction into a heater, (ii) contamination of the organometallic compound during the sampling operation, and (iii) repeatedly sampling on every analysis). (See also description at page 3, lines 10 to 18 of the present specification.)

Therefore, Barnes US '935 does not give any motivation to arrive at the present invention.

Distinctions over Carnahan US '861

Carnahan US '861 merely discloses a recirculating filtration system for use with a transportable ion mobility spectrometer. In Carnahan US '861, a gas cylinder is disclosed.

However, Carnahan US '861 fails to specifically disclose or suggest the features of the present invention (e.g., the liquid mass flow controller and the in-line monitor disposed downstream of a vaporizer).

Accordingly, Carnahan US '861 does not provide any motivation to arrive at the present invention.

Distinctions over Mitsumaki US '183

Mitsumaki US '183 also fails to specifically disclose or suggest the features of the present invention (e.g., the liquid mass flow controller and the in-line monitor disposed downstream of a vaporizer).

Thus, Mitsumaki US '183 does not provide any motivation to arrive at the present invention.

Combination of the Cited References

A *prima facie* case of obviousness is not established even if the cited references are combined since none of the cited references disclose or suggest the features of the present invention (e.g., an in-line monitor for measuring concentration of vaporized liquid reagent in a mixture of a vaporized liquid reagent and a carrier gas disposed downstream of the vaporizer (and upstream of the ICP emission spectrometer)), which is recited in independent claim 1. Likewise, it follows that a person having ordinary skill in the art would not be motivated by any of the teachings of the cited references to arrive at the present invention.

Accordingly, the present invention (independent claim 1 and dependent claims) is not obvious over the cited references.

New Claim 3

As recited in claim 3, the system of the claimed invention has the in-line monitor comprising an IR absorption cell, through which the organometallic compound gas is passed, and an IR detector for measuring an IR absorption characteristic of the gas organometallic compound gas.

However, none of the cited references disclose and suggest such a feature.

Thus, a *prima facie* case of obviousness is not established even if the cited references are combined.

Accordingly, the present invention (claim 3) is not obvious over the cited references.

CONCLUSION

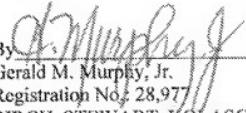
Based upon the amendments and remarks presented herein, the Examiner is respectfully requested to issue a Notice of Allowance clearly indicating that each of the pending claims 1-3 are allowed under the provisions of Title 35 of the United States Code.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Gerald M. Murphy, Jr. (Reg. No. 28,977) at the telephone number below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

Dated: April 9, 2007

Respectfully submitted,

By 
Gerald M. Murphy, Jr.
Registration No. 28,977
BIRCH, STEWART, KOLASCH & BIRCH, LLP
8110 Gatehouse Road
Suite 100 East
P.O. Box 747
Falls Church, Virginia 22040-0747
(703) 205-8000
Attorney for Applicant